Matthew McRaven

Georgetown M.S. student in Computer Science, Software Engineer 🔗

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Languages ──────

- C++
- Python
- QMake & CMake
- LaTex
- Bash
- Java
- Verilog

Frameworks & Libraries ──────

- Qt
- Docker
- Kubernetes
- POCO
- PyTorch
- Numpy
- Boost
- Flatbufs & Protobufs
- Verilator

Working Experience

2018 – Present   **Research Programmer** using Qt/C++   Pepperdine University
- ★ Designed control section for CISC processor (Pep/9) and a corresponding graphical processor simulator.
- ★ Designed new processor architecture (and 3 simulators at various abstraction levels) named Pep/10, featuring a linking macro-assembler.
- Implemented an interactive, graphical cache simulator for the Pep/9 and Pep/10 architectures.
- Improved ISA simulation performance by $600\times$ (written in C++).
- Rewrote simulators to promote code reuse (~130k LoC $\Rightarrow$ ~60k LoC).
- Programmed operating system—including an object code loader—in assembly for Pep/10 architecture

2015 – Present (Summers)   **Software Engineer** using C++/Qt/Boost/Docker   SabrixTax LLC
- ★ Designed C++ microservices for performant, available geolocation queries using Docker & Kubernetes.
- ★ Prototyped software router with dynamic routing rules for tax computations using C++/Boost.
- Refactored existing Qt/C++ applications to promote code reuse and automate cross-platform deployment.
- Designed C++ & Python HTTP clients for replaying taxable transactions.
- Replaced existing regression testing suite–written in Excel–with custom, backward-compatible Qt regression testing tool.

2019 – 2020   **Research Assistant** using Python/Javascript   Georgetown University
- ★ Helped design architecture for real-time network traffic capture and analysis using Python.
- Built visualization tool for network traffic flow using Python, Flask, and D3.js.

Fall 2019   **Teaching Assistant**   Pepperdine University
- Organized review sessions for students taking formal methods.
- Graded student-derived proofs of theorems.

Education

2019 – 2021 (expected)   **M.S. in Computer Science**   Georgetown University   Current GPA 3.95 / 4.00

Designed DNN to assist in post-election risk-limiting audits.
Implemented and verified portions of Pep/9 on a FPGA using Verilog.
Performed verification of Pep/9's microcode using symbolic execution.

2015 – 2019   **B.S. in Computer Science/Mathematics**   Pepperdine University   GPA 3.73 / 4.00

Graduated *Magna Cum Laude*.
Presented senior capstone detailing a novel CPU simulator, Pep9Micro 🔗.
On medical leave for Fall 2018.
Studied in Heidelberg, Germany Fall 2016 – Spring 2017.

2011 – 2015   **High School Diploma**   Tigard Senior High School

Graduated Valedictorian from Honors School Program.   GPA 4.00 / 4.00

Courses

Undergraduate	
Programming principles in C++	Statistics
Data Structures in C++	Formal Methods
Computer Systems & Assembly Programming	Discrete Structures
Logic, concurrent, & functional programming	Linear Algebra
Computer Organization	Single, multivariable, and vector calculus
Networking & distributed systems,	Automata Theory
Operating Systems & Systems Programming	Analysis of Algorithms

Graduate	
Realtime Systems Verification	Analysis of Algorithms
Introduction to Deep Neural Nets	Deep Reinforcement Learning
Network Security	Computer Security & Voting Systems
Computer Hardware	Computer Vision & Image Processing

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Tools

Proficient in 🪟🐧🍎

- **git** Git
- 🦊 GitLab CI/CD
- Qt Creator
- 🪟 MS Visual Studio
- 🜚 Klee
- 🇼 MS Office Suite
- 🔣 Slack

Research Interests

- Machine Learning
- Processor simulation
- Computer architecture
- Cloud Computing

Developing Skills

- 🔢 TensorFlow
- ⇄ SoC Communication Architectures
- 🎮 Godot

Awards / Presentations

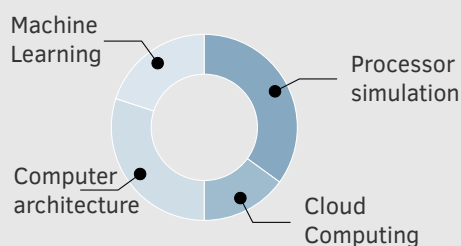|		
2019 – present	**Computer Science Merit Scholarship**	Georgetown University
	Awarded to top 10% of incoming M.S. students.	
2019	**Symbolic Verification of a CISC Processor** 🔗	Georgetown University
2019	**Computer Science Student of the Year**	Pepperdine University
	Chosen as top C.S. student of the class of 2019.	
2017 – 2019	**Northrop Grumman Scholarship**	Pepperdine University
	Awarded to top C.S. students at Pepperdine	
2019	**Pep9Micro: Merging Abstractions CPU** 🔗	Pepperdine University
	Presentation describing the design of the `Pep9Micro` simulator.	
2018	**Pep9Micro: Designing a Microcoded CPU** 🔗	SCCUR
	Poster presentation on designing a new pedagogical CISC processor.	

Research Projects

2019 – present   **Pep/10** 🔗   *Pepperdine University*

Pep/10 is an in-development suite of tools to teach assembly language & computer organization concepts. It is a revision of Pep/9 featuring a macro-enabled assembly language.

- ★ Developed multi-pass assembler tool-chain to handle static linking and macro expansion.
- • Designed a recursive-descent parser for the new macro-enabled assembly language.
- • Created automated regression tests to evaluate the reliability of new assembler tool-chain.
- • Automated deployment/unit-testing via GitLab CI/CD.
- • Integrated Pep/9 and Pep/10 codebase to further promote code reuse.

2020   **ConvVote** 🔗   *Georgetown University*

`ConvVote` is a pipeline of tools to assist in performing post-election risk-limiting audits using convolutional neural nets and generative adversarial nets in PyTorch. Initial results indicate high degrees of accuracy ($> 98\%$) for determining voter intent on ballots.

- ★ Implemented a CNN to provide per-contest voting information.
- • Identified contests on an unmarked ballot using COCO.
- • In-progress GAN to generate marked ballots.

2019 – 2020   **Symbolic Verification of Pep/9** 🔗   *Georgetown University*

`Pep9Milli` is an attempt at verifying the correctness of the Pep/9 processor using symbolic execution `Klee`. It introduces a new hardware control language *millicode* that is easier to debug than existing microcode.

- ★ Verified that the Pep/9 CPU hardware/microcode adheres to its RTL specification.
- ★ Discovered existing bug in Pep/9's microcode.
- • Performs symbolic execution on millicode to verify processor correctness.
- • Paper publication describing verification effort is in progress 🔗.

2019 – 2020   **RaceCar Channel Analysis**   *Georgetown University*

No common tools or frameworks exist for channel obfuscation evaluation; so the current project aims to evaluate the performance and security of obfuscated channels at scale.

- ★ Implemented and tests message queueing tier for captured packets.
- • Created visualizations for network traffic flow.

2018 – present   **Pep/9** 🔗   *Pepperdine University*

Pep/9 is a deployed tool suite to teach assembly language & computer organization concepts. Designed & built a hardware implementation of the Pep/9 processor.

- ★ Designed microcode/hardware implementation of the Pep/9 processor.
- ★ Developed unified graphical microcode/ISA simulator, named `Pep9Micro`.
- • Implemented advanced assembly debugging features in ISA-level simulators, such as step into, over, & out of functions.
- • Created a terminal interface to the Pep/9 system, allowing for automated instructor grading of programming assignments.
- • Rewrote existing (`Pep9` & `Pep9CPU`) applications to promote code reuse.

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Hobbies ⸻

Extra-Curricular Activities

2015 – 2019	Child Program Volunteering	Pacific Palisades Cavalry Church
2013 – 2014	Math Tutor	Tigard High School
2012 – 2015	Martial Arts Instructor	Family Martial Arts Academy

References

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